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Investigation of Arctic mixed-phase clouds by combining airborne remote sensing and in situ observations during VERDI, RACEPAC and ACLOUD

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To improve our understanding of Arctic mixed-phase clouds a series of airborne research campaigns has been initiated by a collaboration of German research institutes. Clouds in areas dominated by a close sea-ice cover were observed during the research campaign Vertical distribution of ice in Arctic mixed-phase clouds (VERDI, April/May 2012) and the Radiation-Aerosol-Cloud Experiment in the Arctic Circle (RACEPAC, April/May 2014) which both were based in Inuvik, Canada. The aircraft (Polar 5 & 6, Basler BT-67) operated by the Alfred Wegener Institute for Polar and Marine Research, Germany did cover a wide area above the Canadian Beaufort with in total 149 flight hours (62h during VERDI, 87h during RACEPAC). For May/June 2017 a third campaign ACLOUD (Arctic Clouds – Characterization of Ice, aerosol Particles and Energy fluxes) with base in Svalbard is planned within the Transregional Collaborative Research Centre TR 172 ArctiC Amplification: Climate Relevant Atmospheric and SurfaCe Processes, and Feedback Mechanisms (AC)3 to investigate Arctic clouds in the transition zone between open ocean and sea ice.
The aim of all campaigns is to combine remote sensing and in-situ cloud, aerosol and trace gas measurements to investigate interactions between radiation, cloud and aerosol particles. While during VERDI remote sensing and in-situ measurements were performed by one aircraft subsequently, for RACEPAC and ACLOUD two identical aircraft are coordinated at different altitudes to horizontally collocate both remote sensing and in-situ measurements. The campaign showed that in this way radiative and microphysical processes in the clouds can by studied more reliably and remote sensing methods can be validated efficiently.
Here we will illustrate the scientific strategy of the projects including the progress in instrumentation. Differences in the general synoptic and sea ice situation and related changes in cloud properties at the different locations and seasons will be addressed to illustrate the broad spectrum of the observations. Exemplary results will be highlighted.